Claims

1. Method for coating substrates (12) with a polar plasma-polymerised layer with a thickness (d) in the nanometer range, having multifunctional properties with long-term stability, wherein the process gas contains at least one each of a hydrocarbon compound, which may be substituted, and at least one inorganic gas, characterised in that coating is carried out

   - in a first zone or stage with process gases which contain at least one hydrocarbon compound, at least one hydrocarbon compound with nitrogen-containing or nitrogen- and oxygen-containing functional groups and/or at least one nitrogen-containing or one nitrogen- and oxygen-containing inorganic gas,

   - in a second zone or stage with nitrogen-free process gases which contain at least one hydrocarbon compound, at least one hydrocarbon compound with oxygen-containing functional groups and/or at least one oxygen-containing inorganic gas.

2. Method according to claim 1, characterised in that coating is carried out at a process pressure (p) of $10^{-3} \leq p \leq 1{,}000$ mbar, preferably $0.1 \leq p \leq 500$ mbar.

3. Method according to claim 1 or 2, characterised in that coating is carried out with process gases, which contain, as organic components, hydrocarbon compounds with up to a maximum of 8 C-atoms, and, as inorganic components, oxygen, nitrogen, hydrogen, carbon dioxide, carbon monoxide, nitrogen oxides, ammonia, at least one halogen and/or at least one noble gas.

4. Method according to any one of claims 1 to 3, characterised in that the lower and/or upper layer (14, 16) is deposited with additional silicon-containing process gases.

5. Method according to any one of claims 1 to 4, characterised in that coating is carried out with a process gas which contains aliphatic, alicyclic and/or aromatic hydrocarbon compounds, preferably with functional polar groups, such as hydroxyl-carbonyl-, carboxylic acid-, carboxyl ester-, amine-, imine-, amide- and/or conjugated nitrile groups.

6. Method according to any one of claims 1 to 5, characterised in that the nitrogen-containing or nitrogen- and oxygen-containing lower layer (14) is applied with a first plasma source, the oxygen-containing upper layer (16) is applied with a second plasma source, or the lower layer (14) and the upper layer (16) are applied from the same plasma source with process gases fed in at various zones or alternating process gases.

7. Coated substrate (10) with at least two multifunctional layers (14, 16) deposited by means of plasma polymerisation, and made of hydrocarbon compounds, characterised in that a plasma-polymerised polar layer (14, 16) in the nanometer range is applied as a nitrogen-containing lower layer (14) applied to the substrate (12), and a nitrogen-free, oxygen-containing polar upper layer (16) is applied thereon.

8. Coated substrate (10) according to claim 7, characterised in that the nitrogen-containing or nitrogen- and oxygen-containing lower layer (14) has a proportion of 40 to 90%, in particular about 50%, of the total layer thickness (d) and the upper layer (16) has a proportion of 60 to 10%, in particular about 50%, of the total layer thickness (d), with the layer thickness preferably being 1 to 100 nm.

9. Coated substrate (10) according to claim 7 or 8, characterised in that the nitrogen/carbon and/or the oxygen/carbon ratio present in the plasma-polymerised polar layer (14, 16) made of substituted hydrocarbon compounds is in the range of 0.3 to 0.8, and in the lower layer (14), the nitrogen/carbon ratio is in the same range.

10. Coated substrate (10) according to any one of claims 7 to 9, characterised in that the polar upper layer (16), averaged in the uppermost approximately 2 nm, has a carbon/oxygen ratio of 0.2 to 0.6, preferably of 0.3 to 0.5, and a permanent surface tension of preferably at least 50 mN/m.

11. Coated substrate (10) according to any one of claims 7 to 10, characterised in that it can also be welded to a plasma-polymerised polar layer (14, 16).

12. Use of the coated substrate (10) according to any one of claims 7 to 11, as a bonding layer (14, 16) for any polar material or any substance, as food packaging or as an anti-fog layer.

13. Use of the coated substrate (10) according to claim 12 for an anti-fog layer, in particular in the food sector.

14. Use of the coated substrate (10) according to claim 12 as a protective layer against migrations to the surface, as a barrier acting on both sides for gases, additives and liquids, as a degradation protection and/or scratch protection layer.